Estimating Transaction-Based Price Indices for Local Commercial Real Estate: An Examination of Methodologies using Property Tax Data

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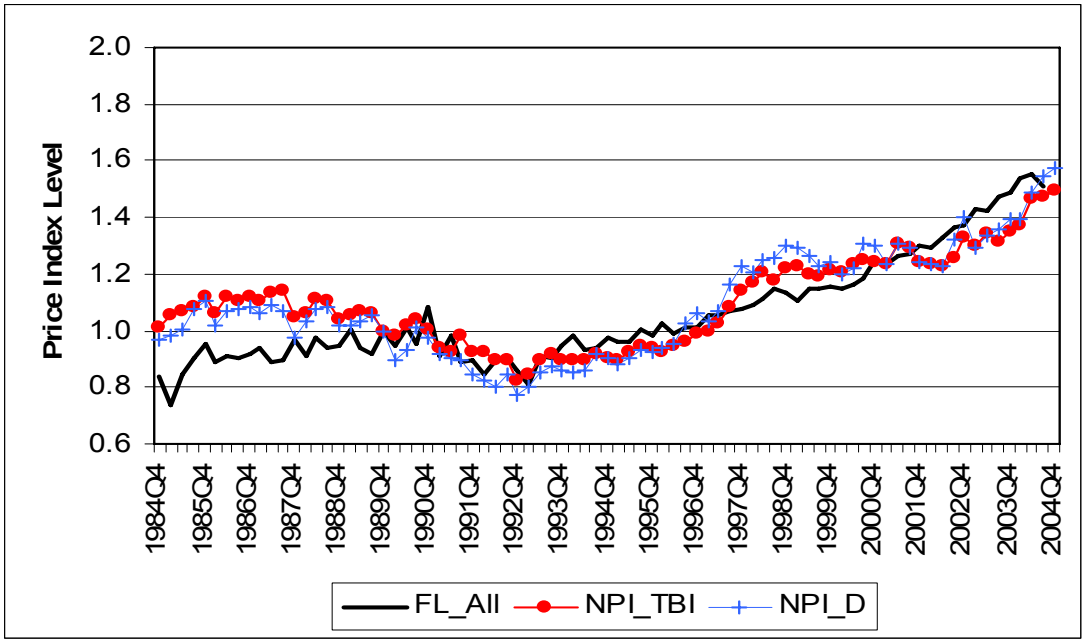
Executive Summary

This study examines the feasibility of constructing reliable transaction-based commercial property price indices using public property tax records. It uses the Clapp and Giacotto (1992) assessed-value method to estimate price indices for commercial properties in the state of Florida using the state's comprehensive property tax data. The method produces promising results that we believe can be developed further to produce reliable local commercial price indices on an ongoing basis.

We compare the results of the Florida Commercial Price Index with that of the NCREIF institutional property index (NPI) and the transaction-based index (NPI_TBI) produced by the Commercial Real Estate Data Library at MIT. Our estimates yield reasonably reliable results for year-to-year property price movements. It is interesting to note that although the underlying data are very different, the average annual increase of the new Florida index is very similar to that of the NPI_TBI for the period examined.

Florida Commercial Price Index v. NPI_TBI
(1985:1 – 2004:4)



Note: FL_All is the transaction based commercial property index for Florida – all sector; NPI_TBI is the transaction based price index of the NPI_P as reported by MIT; NPI_TBId is the transaction based demand (constant-liquidity) index of the NPI_P as reported by MIT.

The reliability of the estimated indices is further supported by comparing the standard deviation of the price movements and first-order autocorrelation behavior of the Florida indices to that of the NPI_TBI. Both are similar when viewed on an annual basis. The standard deviation of annual changes in the Florida index is 7.7% compared to 7.9% for the NPI_TBI, and have first-order autocorrelation coefficients of 37% to 39%, respectively. Finally, the Florida index has a correlation coefficient of 0.75 with the NPI_TBI and leads the standard NPI. The Florida index, lagged one year, has a 75% correlation coefficient with the NPI. Quarterly indices are also constructed. While the mean quarterly changes are reasonable, autocorrelation characteristics are highly negative suggesting that the indices are estimated with substantial noise.

In addition, our study provides a comparison of the price performance of small and large property values. Properties in the Florida index had a 2005 mean price of just over $2 million. This compares to an average property value in the NCREIF of over $30 million. It is interesting to note that average appreciation rates of the Florida index are estimated to be similar to the NPI. Still, larger commercial properties (those greater than $1 million) within Florida appear to have appreciated at greater rates than smaller properties. Overall though our property value analysis indicates that while there are likely small differences between the value cohorts, the NPI_TBI and the FL_ALL index are strikingly similar. Because the within-Florida benchmark comparisons include biases associated with defining the value cohorts, more work needs to be conducted in this area before definitive conclusions can be drawn about the relative performance of smaller and institutional-grade properties.

Estimating Transaction-Based Price Indices for Local Commercial Real Estate: An Examination of Methodologies using Property Tax Data

Gatzlaff and Holmes

I. Introduction

The accurate measurement of movements in property values is a fundamental goal of real estate research. The importance of price and return indices cannot be overstated; their use is central to portfolio allocation decision-making, performance benchmarking, and a wide range of economic analyses. The NCREIF Property Index (NPI) has served as the standard for some time now, despite several drawbacks. In particular, its use of periodic appraised values to estimate price movements create well-known smoothing and lagging deficiencies.

Estimates of indices based on transaction data represent an alternative since they avoid the issues associated with the use of appraisals. However, they are not without deficiencies due to infrequent trading and heterogeneous assets. Still, Fisher, Geltner, Pollakowski (2005); Fisher, Gatzlaff, Geltner and Haurin (2003); and Gatzlaff and Geltner (1998) have used the NCREIF data source and associated sales data to construct transaction-based indices.

The first goal of our paper is to extend this work using data from state property tax records. We seek to show that reliable transaction-based commercial property indices can be constructed using this data. Since comparable data would presumably exist for every state of the union, what we demonstrate can be broadly applied.

To analyze the reliability of our price index, we compare its performance characteristics to two existing indices: the NPI (which is an appraisal-based index that uses data supplied by approximately 50 institutional owners); and the transaction-based index (TBI) created by Fisher, Geltner and Pollakowski (2005) which uses the same underlying property data as the NPI.

We compare our Florida Commercial Price Index to these existing indices in several ways. We plot the indices graphically, we compare means, standard deviations and serial correlations for quarterly and annual price changes, and we calculate the correlation coefficients.

Our estimates yield reasonable results for year-to-year property price movements. The 1991 to 2000 average annual increase of the new Florida Commercial Property Index is similar to the TBI and has a standard deviation of 7.7% as compared to 7.9% for the TBI, with first-order autocorrelation coefficients of 39% and 25%, respectively. This compares to first-order serial correlation in the NPI of 75%. The new index has a correlation of 75% with the TBI and leads the NPI. The Florida index lagged one year is positively correlated (correlation coefficient = 0.75) with the NPI index.

The comprehensive nature of our database allows us to analyze price changes in various subsets. We provide breakdowns to property sectors and compare our results to existing indices. In addition, we can segment by size and compare the price changes, and this represents the second important goal of our paper. We consider this to be a valuable contribution since our knowledge of returns to date is associated with the presumably larger properties held by the institutions that contribute data to NCREIF.

Ziering and McIntosh (1999) is one of the few papers to analyze the relationship between property size and performance. They focus on the performance of "trophy" properties, which they define to be those with a value exceeding $100 million. They find that "trophy" properties have higher and more volatile returns. Their data source was the properties included in the NCREIF.

We subdivide our database and report price characteristics by quartile, comparing the means, standard deviations and correlations of the price movements. We find that higher-value properties tend to have higher price appreciation and higher standard deviations. Using a Chow test, we find statistically significant differences in the price indices for smaller-value properties relative to higher-value properties.

This paper is organized as follows. We begin with a discussion of the application of the fundamental price index estimation methods to commercial property in Section II. In Section III,

we describe the data. Section IV discusses the estimation method applied and reports the results. This is followed by Section V, the Conclusion.

II. Constructing Commercial Price Indices

Until recently, transaction data for commercial property have not been widely available; thus, the development of transaction-based local area price indices for commercial property has trailed that of housing market indices. The NCREIF Property Index (NPI) is the most widely used benchmark for gauging the performance of investment property price performance. In addition to the U.S. index, the NPI is estimated for five property segments (i.e., apartment, hotel, industrial, retail and office) and for four U.S. regions (i.e., East, South, Midwest, and West). Although the NPI is very useful, it has some deficiencies. Most notably, changes in the price movements of the index have been shown to be "smoothed" or "lagged" due to the nature of the appraisal process and the aggregation in the index construction.

In addition, the NPI reflects movements in the "institutional grade" properties held by the NCREIF members, which may substantially differ from the broader population of commercial properties. Institutional grade properties tend to be substantially larger and commanding prime locations within major metropolitan areas. As such, they are often viewed as less risky, transacted by informed and specialized "institutional" segments of the market, and substantially higher priced than other more typical properties in the market.

Three basic method of estimating price indices are often reported: (1) median sales price data; (2) estimates from hedonic regressions, and (3) repeat-sales methods. There are of course variations and combinations of these methods. Median sale price data for properties sold during a particular period (or across locations) do not hold constant the quality (e.g., size, materials, and technology) of the individual properties sold. Changes in the characteristics of the properties sold at any given time can, of course, be very significant in the commercial market due to the relatively small number of transactions that can occur each period. Thus, an increase (decrease) in

the median sale price of the property sold from period to period may not accurately reflect the true overall market increase (decreased) in value.

Hedonic indices are constructed by estimating the regression equation,

$$\ln P_{it} = \sum_{j=1}^{k} \beta_j \ln X_{jit} + \sum_{t=1}^{T} c_t D_{it} + e_{it} \quad (1)$$

where P_{it} is the transaction price of property I at time t, I = 1,…,n, and t = 1,…,T; j = 1,…,k, are a vector of coefficients on the structural and locational attributes, X_{jit}; ct the time coefficients of D_{it}, time dummies with values of 1 if the ith property sold is in period t and 0 otherwise; and e_{it} is the random error with mean, 0, and variance σ_e^2. Estimates of the coefficient, c, yield measures of price movements associated with each intervening time period, relative to a base period. Hedonic estimates have been widely employed in developing house price indices as one method of controlling for temporal and cross-sectional differences in the quality of the properties transacted. The rationale is that heterogeneous housing can be viewed as a bundle of separately measurable characteristics. Transaction prices are regressed on varying structural and location characteristics to estimate their implied marginal prices to the composite price. However, the value movements of commercial property are tied to their income producing characteristics. Modeling the income producing characteristics is difficult. The large cross-sectional data sets and long-term time series panels of micro economic variables and property characteristics are very difficult and expensive to assemble. Hedonic estimates of commercial property values have not proved reliable. In addition, omitted characteristics that affect property prices, the choice of functional form, and sample selectivity all present potential estimation problems.

Similar deficiencies in the residential market have given rise to the development and use of repeat-sales indices. The repeat sale estimation equation can be viewed as the differencing of two hedonic equations (1),

$$\ln P_{it} - \ln P_{i\tau} = \sum_{j=1}^{k} \beta_j \ln X_{jit} - \sum_{j=1}^{k} \beta_j \ln X_{ji\tau} + \sum_{t=1}^{T} c_t D_{it} - \sum_{\tau=1}^{T} c_\tau D_{i\tau} + e_{it} - e_{i\tau} \quad (2)$$

where P_{it} and P_{iT} are the prices of the two repeat sales, with the initial sale at time T and the second sale at time t. If the structural and locational attributes (X characteristics) are held constant between sales, they drop out of the equation and it can be estimated as,

$$\ln\left(\frac{P_{it}}{P_{i\tau}}\right) = \sum_{t=1}^{T} \gamma_t D_{it} + \varepsilon_{it\tau} \quad (3)$$

where $\left(P_{it} / P_{i\tau}\right)$ is the price relative to property I; D_{it} is a dummy variable which equals -1 at the time of the initial sale and +1 at the time of the second sale, and 0 otherwise; γ_t is the logarithm of the cumulative price index in period t; and e_{iTt} is the disturbance term.

Repeat-sale methods have been shown to produce reliable estimates of the rate of appreciation. Implementation of the repeat-sales methodology requires transaction data (sale prices and dates) from individual properties that sold at least twice over the study period. If the quality of the property that sold twice is unchanged between the two sale dates, the difference between sale prices of the same property at different dates is a function solely of the intervening time period. Repeat-sales estimates are limited in that they do not hold constant the age of the property and the property prices may be affected by improvements occurring between the sale dates. In addition, the data may be selective in that they include only properties that have sold at least twice. Gatzlaff and Geltner (1998) show that repeat sale methods can be applied to estimate commercial property prices; however the data requirements are substantial and prohibit their application to local areas or segments of the property market.

Clapp and Giacotto (1992) address the efficiency and sample selectivity issues by modifying the repeat sale model by using the assessed value of the property at the beginning of

their study period as a proxy for the first sale (or sale characteristics). If the assessed value is an unbiased estimate of market value it can be substituted into the repeat sale equation such that,

$$\ln\left(\frac{P_{it}}{AV_{i\tau}}\right) = \sum_{t=1}^{T} \gamma_t D_{it} + \varepsilon_{it\tau} \qquad (4)$$

where P_{it} is the price of the sale at time t and AV_{iT} is the assessed value at time T. The advantage of this method is that it allows the number of observations to be easily increased because estimation only requires one sale and an appraised value. Repeat sale observations are not required. The Clapp and Giacotto (1992) model relaxes the AV_{it} assumptions by placing the assessed value, AV_{it}, term on the right-hand side of the equation and allowing it to be a constant ratio of the market value. Clapp and Giacotto show that the AV method can produce efficient and unbiased estimates of the price movements, and can be used to construct reliable price indices. Gatzlaff and Ling (1994) report that the AV method produces indices similar to the repeat sale method when used to estimate housing market data. Because assessed value data are widely available, and it substantially controls for changes in quality among properties, it is plausible that local area commercial property price indices could easily be estimated using this method.

III. Data

The transaction data used for this study have been obtained from the Florida Department of Revenue (DOR). The DOR data are compiled annually under a statutory provision requiring the auditing of each of the 67 counties' property tax master files. The complete set of records contains information on every parcel in the state of Florida, including all commercial property. The data, maintained in annual files constructed as a cross-sectional county-specific database, include the two most recent sale prices and sale dates (if sold and sold repeatedly), the property type, size, its assessed value, its effective year built, and a limited number of other property- and owner-specific characteristics.

The database was constructed by merging the 2005 property tax records for all 67 counties in Florida. The entire dataset is comprised of about 9.3 million parcels, of which approximately 265,000 (2.9%) are categorized by the DOR as commercial properties.[1] From these data a subset of properties were selected having land use codes consistent with (1) apartment (more than 10 units), (2) industrial, (3) office, and (4) retail properties types and include sales observations for the periods prior to 2005.

A series of steps were conducted to mitigate the effect of properties having experienced substantial changes to capital improvements (renovation or demolition) during the study period. All properties coded as having an effective year built after its sale date, possibly due to renovation and improvements, were deleted. Observations were deleted if the assessed value of the land was greater than the assessed value of the property. Properties were excluded that were identified as vacant parcels and observations were deleted if there was evidence of coding errors.

Finally, the properties selected were limited to those coded by the local property appraiser offices as arm's length "qualified" transactions and having transacted for more than $150,000. The sampled data set consists of 32,610 properties (3,361 apartment; 7,510 industrial; 14,180 retail; and 7,559 office properties) that were recorded as selling between 1980 and 2005.[2]

Descriptive statistics are reported for the data in Tables 1 and 2. Table 1 indicates a general profile of the data by year (1980 to 2005). As expected, the number of sale observations increase from 114 in 1980 to 4,643 in 2004.[3] The 1980 to 2005 data set is used to estimate the indices; however, a sufficient number of observations are not available in the early years (i.e., 1980 to 1985) to provide reliable index levels. The table indicates that the data represent property values ranging from $150,000 to $207 million. Note that the median sale price ranged a low of

[1] Of the 9.3 million parcels, 2.9 percent are commercial properties (multifamily with 10 or more units, hotel, industrial, office or retail); 19.5 percent are vacant parcels; 68.8 percent are residential (including multifamily with less than 10 units); and 8.8 percent are agricultural, institutional, or governmental.
[2] We deleted all observations that had the most recent sale date before the last quarter of 1979. There were very few properties that had their most recent sale in the 1960s and 1970s. In addition, we deleted any properties with the year built coded as prior to 1901.

$250,000 in 1980 to almost about $628,000 in 2005. Interestingly, the mean ranged from about $600,000 in 1980 to almost $2.3 million in 2005. The large differences in the yearly median and mean prices reflect the skewed nature of the sale price data.

Table 2 reports the number of observations, mean assessed values, aggregate assessed values, minimum, and maximum sale price information for each property type cohort. Note that retail properties represent approximately 43.5% of the properties in the database. The remainder of the database is composed of office (23.2%) industrial (23%); and apartment properties (10.3%). Each apartment property is valued on average at just over $3.1 million, office properties at $1.2 million, industrial properties at about $1.0 million, and retail properties just under $1.0 million. Thus, the aggregate values of the total portfolio examined are 35.1% retail, 25.3% apartment, 23.1% office and 16.5% industrial. It should be noted that retail and office properties make up approximately 66%; apartment properties 17% and industrial properties 16% of the entire $265 million population of properties. Thus, apartment properties are slightly over-represented in the sample. The maximum sale prices in the data are retail and office properties which sold at $100 million and $207 million, respectively. It should be noted that the properties used in this analysis are much smaller than the typical property included in the NCREIF index, where the average property is valued at about $30 to $40 million.

IV. Methodology and Results

To examine the feasibility of developing transaction-based indices using local property tax data we modify the assessed-value method introduced by Clapp and Giaccotto (1992) to estimate the index. Our estimation equation is

$$\ln P_{i\tau} = \alpha A_{it} + \sum_{t=1}^{T} \gamma_t D_{it} + \varepsilon_{it\tau} \tag{5}$$

[3] The 2005 DOR data file includes sale information through June of 2005 for a small number of counties. These are listed, but not sufficient to provide reliable estimates for 2005.

where AV_{it} is the assessed value of the property at time t and P_{iT} is the most recent sale price at time T. The database contains one observation for each property i with the assessed value for 2005 and the most recent sale price in time t. The antilog values of the coefficients c_1 to c_T provide estimates of the price indices. The resulting quarterly index is graphed in Figures 1 and 2. For comparison, Figure 1 also displays the capital appreciation component of the NPI and Figure 2 also displays the TBI and the constant-liquidity version of the TBI. Causal examination of Figures 1 and 2 suggests the price movements of the FL Commercial Property Index are remarkably similar to the TBI, especially from 1990 through 2004. All indices capture the decrease in prices from 1990 to 1992, followed by a persistent climb in prices through 2004. The TBI indicates a pronounced increase in 1997 and 1998, while the FL Property Index shows more subtle movements.

Table 3 reports the results of the comparison between the new and existing indices. The mean, standard deviation and first-order serial correlation of the quarterly and annual index values for the new index are compared to the existing indices for periods 1985 to 2004. Our estimates yield reasonable results for year-to-year commercial property price movements. The mean quarterly price increases of FL_ALL in Panel A are higher that the NPI_TBI, 0.9% to 0.5%, as well as their standard deviations. The negative first-order autocorrelation in FL_ALL suggest estimation error in the quarterly estimates.

Looking at Panel B we see that FL_ALL is again higher than NPI_TBI, with means of 3.4% and 1.7% respectively. This is due to the 1984 to 1990 period, when the NPI_TBI experience persistent declines in price, while FL_ALL increased. In is interesting to note that the standard deviation of the annual returns of FL_ALL and NPI_TBI are of a similar magnitude.

The annual price changes of FL_ALL are similar to the NPI_TBI, when we focus on the period from 1991 to 2000. (This time frame eliminates any truncation effects that exist at the beginning and end of the dataset). For this same timeframe, the annual standard deviation of 7.7% compares to 7.9% for the NPI_TBI. The first order autocorrelation of 39% is lower than the

NPI and similar to the other indices. The FL_ALL index has a correlation coefficient of 75% with the NPI_TBI when we look at this period. In addition, our transaction based index leads the appraisal based NPI, as evidenced by 75% correlation with the lagged NPI index.

Our estimates indicate that although price levels are estimated with some precision at the quarterly level and average returns are reasonable, there is substantial "noise" in the changes in the quarterly index. This is evidenced by the large level of negative first order autocorrelation in the series. Also, the standard deviation of changes in the quarterly index is 1.5 to 2.0 times larger than the transaction based TBI.

Figure 3 displays the new Florida Commercial Property Index by sector. Figures 4, 5, 6 and 7 show the new index against the NPI_TBI for the apartment, industrial, office and retail sectors. Again, the price levels appear to be generally estimated with reasonable precision in comparison to existing indices. It is interesting to note that annual movements of the sectors deviate from the total market and are persistent. For example, the office market is substantially different from that of the NPI_TBI office sector.

Table 4 shows the mean, standard deviation and serial correlation for the quarterly and annual price changes for Florida Commercial Property and the NPI_TBI, and for each of the sectors. It is interesting to note that while there are differences, the average rates of appreciation are similar for many sectors on both a quarterly and annual basis. It is apparent that the quarterly estimates are measure with substantial error, as evident in the high negative autocorrelation statistics. Otherwise, both the first and second moments are similar.

Examining the annual price changes by sector indicates more reliable estimates of the Florida sectors. The first and second moments are again very similar, and there is some correlation between the national institutional and local markets for apartments (33%); industrial markets (73%); and retail markets (29%). The national institutional index is shown to be largely uncorrelated with Florida's local office market (-0.12%) Further work is required to determine

whether this is an artifact of the estimation procedures or if the Florida office sector is genuinely quite different from the national market.

The final analysis focuses on the difference in property appreciation rates for different property values. In Table 5, the comprehensive database is divided to quartiles based on the 2005 assessed value. The assessed value range per quartile is reported, along with the mean and standard deviation of the annual price movements. The highest mean annual price movement is for the third quartile, and the lowest mean annual price movement is for the first quartile. Table 5 shows that the mean annual price movement was 1.2% for properties with a value of less than $285,000 (the standard deviation is 7.19%); 3.41% for properties with 2005 assessed values in the second quartile ($285,000 to $479,000); 4.22% for properties with assessed values in the third quartile ($479,000 to $990,000); and 4.0% for properties greater than $990,000. Figure 8 graphs the smaller-value (<$1m) and larger value (>=$1m) property indices.

Finally, a Chow test was conducted to more formally analyze the difference in property appreciation rates for different property values. The estimation equation is

$$\ln P_{i\tau} = \alpha A_{it} + \sum_{t=1}^{T} \gamma_t D_{it} + \sum_{t=1}^{T} b_t I_{it} + \varepsilon_{it\tau} \qquad (6)$$

$ln(sale_i) - ln(assessed\ value_i) = a_0 + a_1 Q_{1i} + ... + a_T Q_{Ti} + b_0 C + b_1 CQ_{1i} + ... + b_T CQ_{Ti} + e$

where I_{it}, is an interacted variable such it is 0 if the property assessed value is in the three smallest quartiles, and 1 if the property assessed value is in the largest quartile. The Chow test evaluates the significance levels of the b_1 to b_T coefficients being greater than zero jointly. The results are reported in Table 6. We find that these coefficients are consistently negative and significant. An F-test encompassing all the b coefficients has a result of $F(100, 40809) = 11.06$, so $p<0.001$. It can be concluded from this test that the index for smaller-value properties is significantly different from that of larger-value properties, confirming the impression from the decile means table in Table 5 Panel A.

V. Conclusion

The purpose of this study is to determine whether it is feasible to produce a reasonable transaction-based commercial property index using property tax records. We compare our results to the NCREIF institutional property index (NPI) and to the transaction-based index (NPI_TBI) produced by the Commercial Real Estate Data Library at MIT and conclude that our estimates yield reasonable results for year-to-year property price movements. The average annual increase of the new Florida Commercial Property Index (FL_ALL) is similar to the NPI_TBI and has a standard deviation of 7.7% as compared to 7.9% for the NPI_TBI. The new index has a correlation of 0.75 with the NPI_TBI and leads the NPI, as evidenced by a 75% correlation with the lagged NPI index.

A second purpose of our study is to compare the performance of properties with small versus large property values. This is an important contribution to the return literature since our knowledge of property returns is now largely limited by the choices of the institutional investors who contribute to the NCREIF database. We therefore offer a first look at the performance of small properties with property values substantially below $1 million. Overall, our property value analysis demonstrates indicate that while there are likely difference between value cohorts, comparisons between the NPI_TBI and the FL_ALL index are strikingly similar. Because the benchmark comparisons are rough, more work needs to be conducted in this area.

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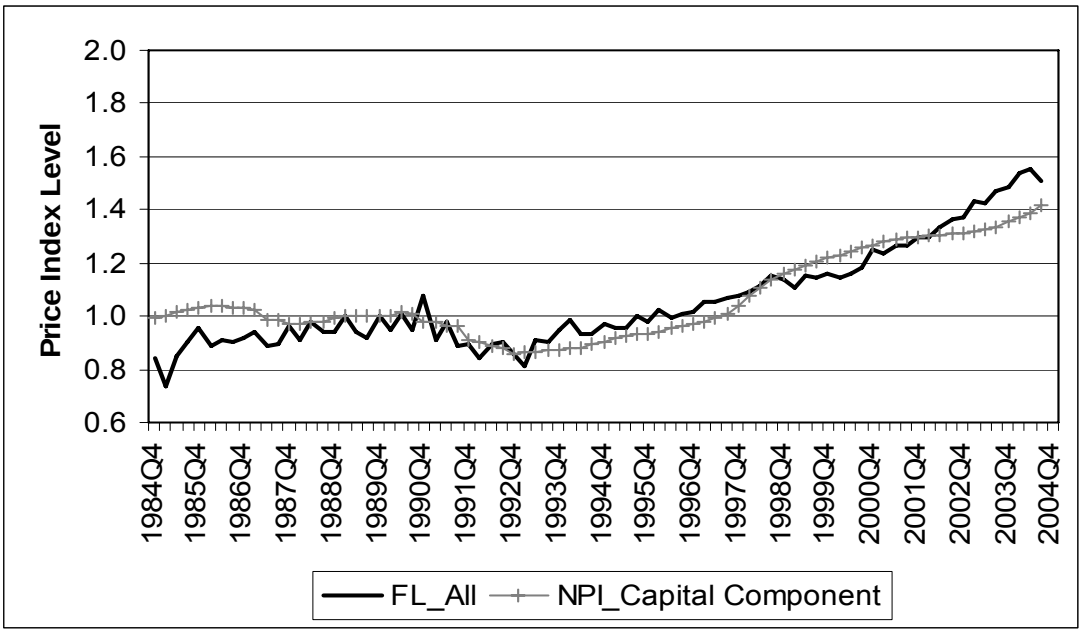
Table 1: Descriptive Statistics of the Transaction Data Listed by Year of Sale (1980 – 2005)

Year	No. Obs	Median Sale Price ($000)	Mean Sale Price ($000)	Std. Dev. Sale Price ($000)	Min. Sale Price ($000)	Max. Sale Price ($000)
1980	114	250	625	1,012	150	8,540
1981	136	260	686	1,160	150	8,900
1982	165	280	576	917	150	6,750
1983	181	280	695	1,408	150	13,500
1984	319	290	784	1,616	150	12,400
1985	330	289	693	2,945	150	51,800
1986	469	300	637	1,453	150	20,500
1987	344	304	592	1,062	150	9,145
1988	486	342	727	1,214	150	12,700
1989	518	340	751	1,397	150	17,100
1990	500	350	728	1,279	150	13,600
1991	464	323	610	861	150	7,625
1992	612	327	823	1,589	150	20,500
1993	854	350	1,198	4,334	150	100,000
1994	1039	350	1,008	2,249	150	21,500
1995	1095	325	914	3,152	150	87,300
1996	1371	375	1,262	6,650	150	207,000
1997	1665	381	1,210	3,018	150	60,700
1998	1992	385	1,220	2,842	150	42,500
1999	2091	395	1,248	3,186	150	44,200
2000	2273	400	1,246	3,088	150	58,800
2001	2665	425	1,295	3,305	150	52,200
2002	3373	445	1,297	4,321	150	172,000
2003	4221	500	1,349	3,375	150	60,800
2004	4643	580	1,514	3,770	150	73,600
2005	690	628	2,252	5,159	150	41,000
TOTAL	32,610					

Table 2: Descriptive Statistics of the Transaction Data Listed by Sector (as of 2005)

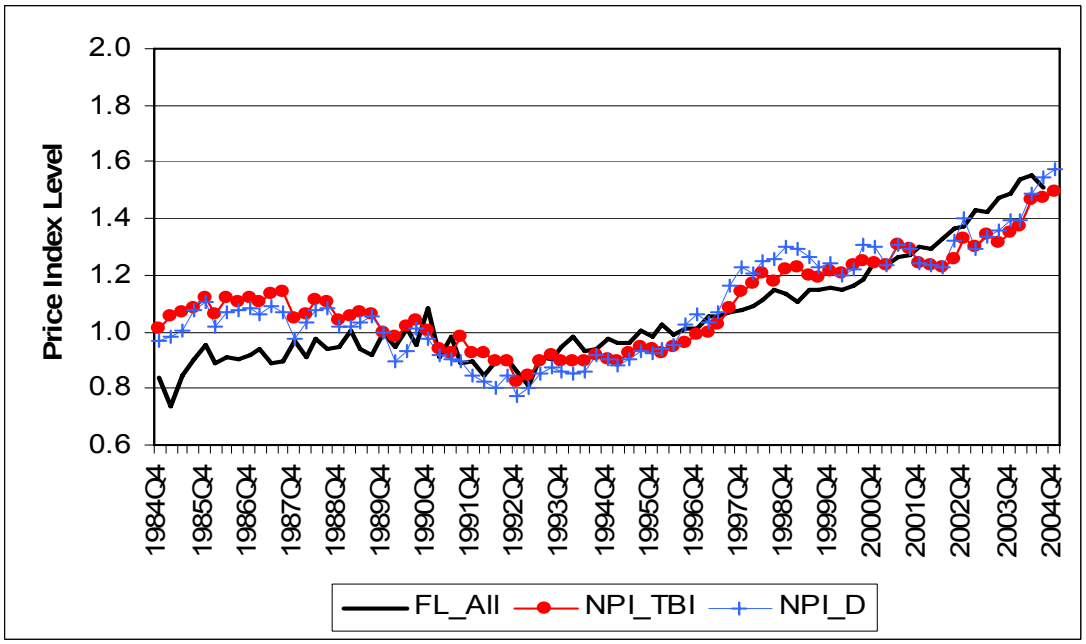
Year	No. Obs	% Obs.	Mean AV ($ Million)	Total AV ($ Billion)	% of Total AV	Min. Sale Price ($000)	Max. Sale Price ($000)
Apartment	3,361	10.3	3.107	10.443	25.3	150	63,100
Industrial	7,510	23.0	0.907	6.810	16.5	150	30,900
Retail	14,180	43.5	1.022	14.496	35.1	150	100,000
Office	7,559	23.2	1.267	9.574	23.1	150	207,000
TOTAL	32,610			41.323			

Figure 1: Florida Commercial Price Index v. NPI Capital Index (1985:1 – 2004:3)



Note: FL_All is the transaction commercial property index for Florida (all properties); NPI is the price component index of the NCREIF Property Index (NPI).

Figure 2: Florida Commercial Price Index v. NPI_TBI (1985:1 – 2004:4)



Note: FL_All is the transaction based commercial property index for Florida – all sector; NPI_TBI is the transaction based price index of the NPI_P as reported by MIT; NPI_TBId is the transaction based demand (constant-liquidity) index of the NPI_P as reported by MIT.

Table 3: Comparison of Estimated Price Index Movements with Changes in NPI_P and NPI_TBI

Panel A: Quarterly Price Changes (1985:1-2004:3)

		NPI_P	*FL_ALL*	*NPI_TBI*	*NPI_TBd*
Mean		0.5%	0.9%	0.5%	0.7%
Std. Dev.		1.3%	6.4%	3.3%	4.4%
First-order autocorrelation		0.58	(0.52)	(0.02)	0.01
Correlation coeff.	*NPI_P*	1.00			
	FL_ALL	(0.02)	1.00		
	NPI_TBI	0.44	(0.04)	1.00	
	NPI_TBId	0.31	(0.02)	0.78	1.00
	NPI_P (t+1)	0.58	0.05	0.12	0.14

Panel B: Annual Price Changes (1985-2003)

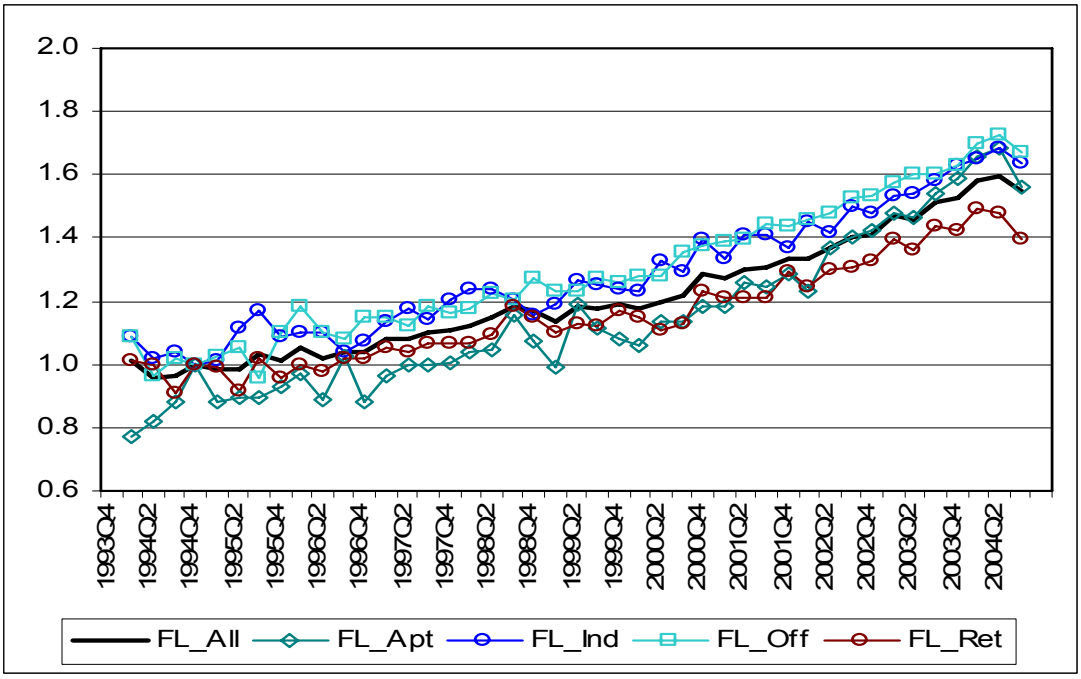
		NPI_P	*FL_ALL*	*NPI_TBI*	*NPI_TBd*
Mean		1.7%	3.4%	1.7%	1.7%
Std. Dev.		4.5%	7.0%	6.6%	8.1%
First-order autocorrelation		0.63	(0.15)	0.23	0.24
Correlation coeff.	*NPI_P*	1.00			
	FL_ALL	0.51	1.00		
	NPI_TBI	0.75	0.63	1.00	
	NPI_TBId	0.71	0.51	0.86	1.00
	NPI_P (t+1)	0.63	0.31	0.55	0.66

Panel C: Annual Price Changes (1991-2000)

		NPI_P	*FL_ALL*	*NPI_TBI*	*NPI_TBd*
Mean		2.7%	1.8%	2.4%	3.3%
Std. Dev.		5.5%	7.7%	7.9%	9.6%
First-order autocorrelation		0.75	0.39	0.25	0.37
Correlation coeff.	*NPI_P*	1.00			
	FL_ALL	0.76	1.00		
	NPI_TBI	0.78	0.75	1.00	
	NPI_TBId	0.72	0.81	0.90	1.00
	NPI_P (t+1)	0.75	0.75	0.79	0.84

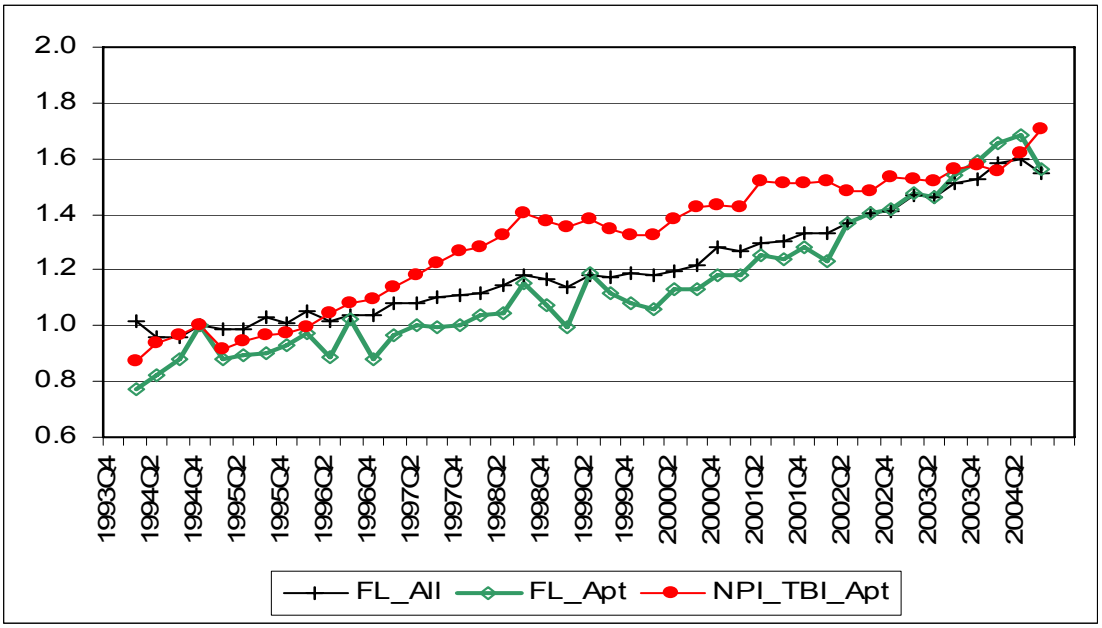
Note: FL_All is the transaction based commercial property index for Florida – all sectors; NPI_P is the price component index of the NCREIF Property Index (NPI); NPI_TBI is the transaction based price index of the NPI_P as reported by MIT; NPI_TBId is the transaction based demand (constant liquidity) index of the NPI_P as reported by MIT.

Figure 3: Quarterly Florida Commercial Price Indices
(All Sectors 1994:1 – 2004:3)



Note: FL_All is the transaction based commercial property index for Florida; FL_Apt, FL_Ind, FL_Off, and FL_Ret denote indices for the Florida's apartment, industrial, office and retail segments, respectively.

Figure 4: Florida Apartment Price Index v. NPI_TBI (U.S. Apt.)
(1994:1 – 2004:3)



Note: FL_Apt denotes Florida's apartment sector; TBI_Apt denotes the U.S. apartment sector as reported using MIT's transaction based index for apartments in the NCREIF portfolio.

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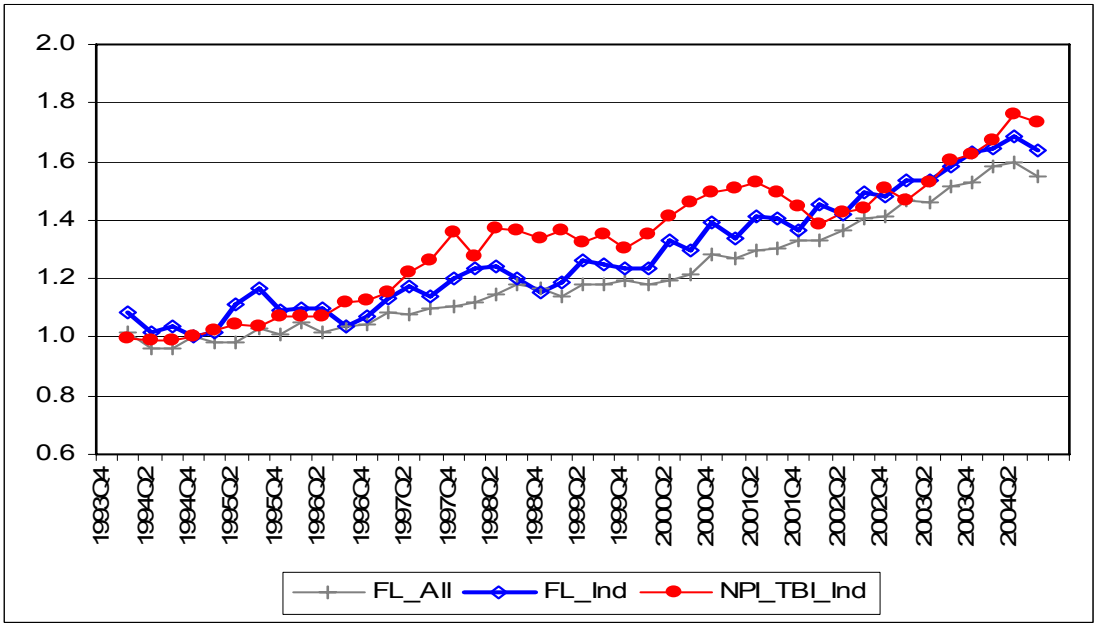
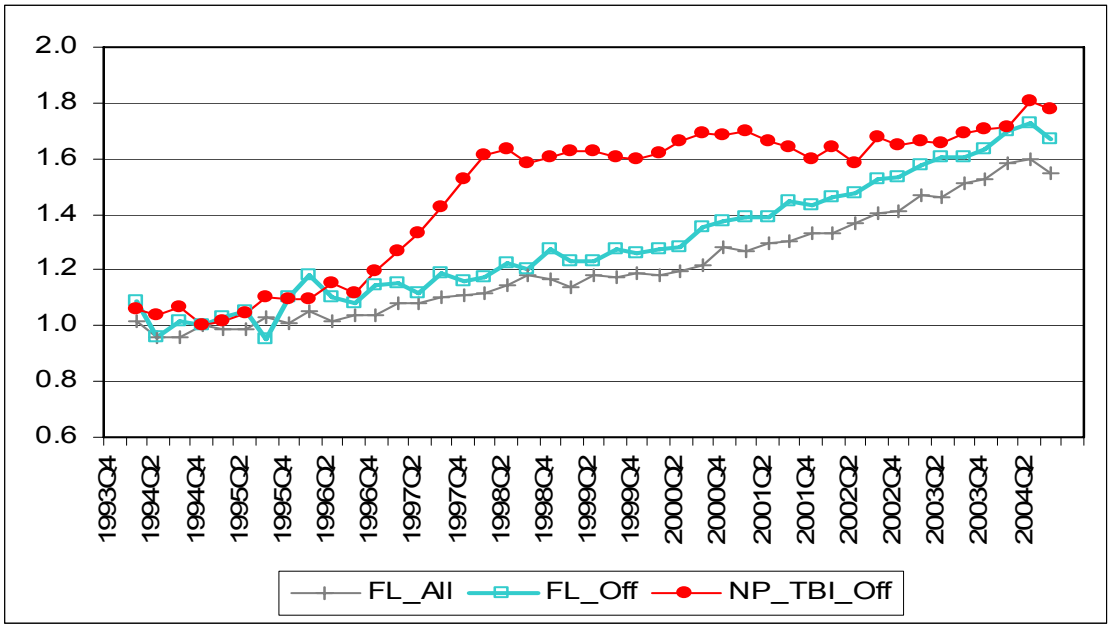
Figure 5: Florida Industrial Price Index v. NPI_TBI (U.S. Ind.)
(1994:1 – 2004:3)



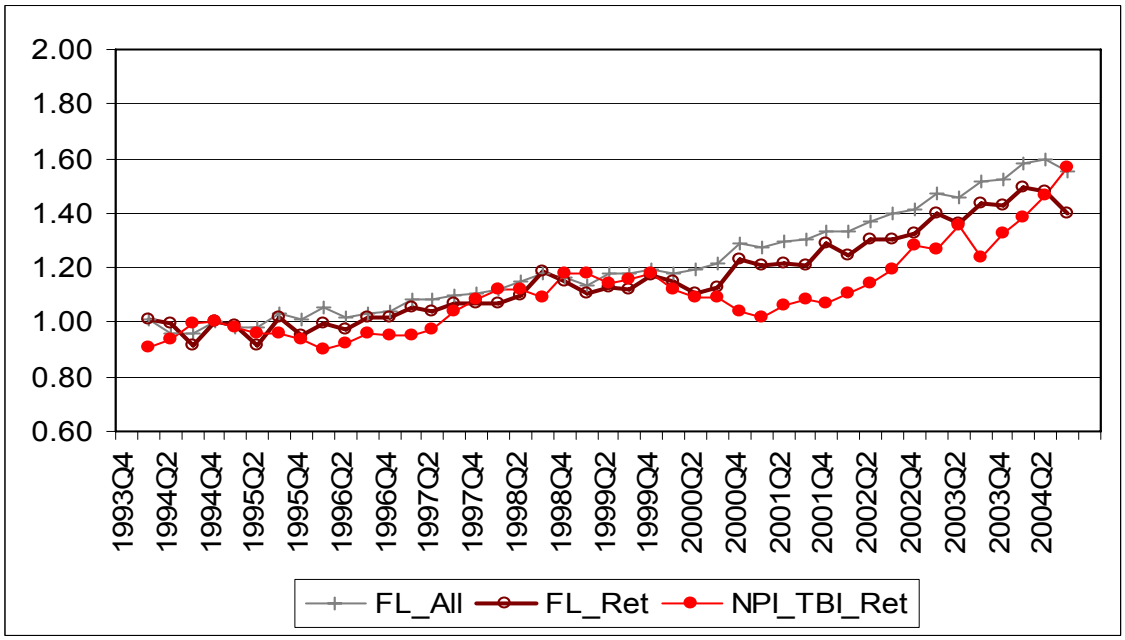
Note: FL_Ind denotes Florida's industrial sector; TBI_Ind denotes the U.S. industrial sector as reported using MIT's transaction based index for industrial properties in the NCREIF portfolio.

Figure 6: Florida Office Price Index v. NPI_TBI (U.S. Ind.)
(1994:1 – 2004:3)



Note: FL_Off denotes Florida's office sector; TBI_Off denotes the U.S. office sector as reported using MIT's transaction based index for office properties in the NCREIF portfolio.

Figure 7: Florida Retail Price Index v. NPI_TBI (U.S. Ind.)
(1994:1 – 2004:3)



Note: (FL_Ret) denotes Florida's retail property sector; TBI_Ret denotes the U.S. retail sector as reported using MIT's transaction based index for retail properties in the NCREIF portfolio.

Table 4: Comparison of Commercial Property Price Indices by Selected Property Types

Panel A: Quarterly Price Changes by Property Type
(1994:2-2004:3)

	FL_All	FL_Apt	FL_Ind	FL_Ret	FL_Off	TBI_Apt	TBI_Ind	TBI_Ret	TBI_Off
Mean	1.05%	2.00%	1.07%	0.95%	1.12%	1.65%	1.38%	1.38%	1.30%
Std. Dev.	2.42%	6.89%	4.12%	4.49%	4.49%	2.97%	3.22%	3.93%	3.32%
S Corr.	-40.5%	-50.5%	-28.6%	-50.1%	-38.1%	1.6%	-19.8%	5.1%	4.1%

Panel B: Annual Price Changes by Property Type
(1995-2003)

	FL_All	*FL_Apt*	*FL_Ind*	*FL_Ret*	*FL_Off*	*TBI_Apt*	*TBI_Ind*	*TBI_Ret*	*TBI_Off*
Mean	4.84%	5.53%	5.76%	4.08%	5.65%	5.34%	5.78%	3.56%	6.43%
Std. Dev.	2.52%	7.58%	6.54%	3.81%	3.91%	6.54%	7.91%	9.51%	9.14%
First-order correl.	-12.6%	31.7%	62.8%	-52.7%	-69.8%	0.9%	-39.8%	12.9%	16.9%

Correlation of Annual Price Movements Between Property Types

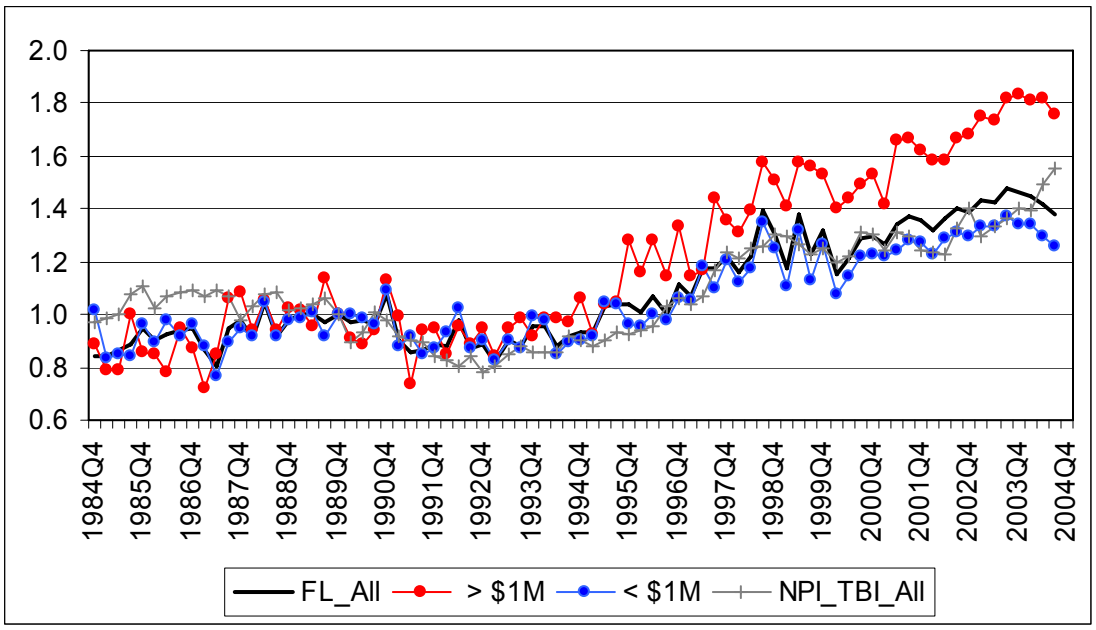
FL_All	1.00								
FL_Apt	0.84	1.00							
FL_Ind	0.37	0.27	1.00						
FL_Ret	0.65	0.55	-0.37	1.00					
FL_Off	0.19	-0.07	-0.04	-0.10	1.00				
TBI_Apt	0.43	0.33	-0.15	0.62	-0.08	1.00			
TBI_Ind	0.49	0.29	0.73	-0.03	0.06	0.52	1.00		
TBI_Ret	0.20	0.48	-0.16	0.29	-0.26	0.23	-0.07	1.00	
TBI_Off	0.17	0.11	0.41	-0.04	-0.12	0.61	0.82	0.23	1.00

Table 5: Annual Price Movements by Property Quartile
(1985-2003)

	FL_All	*Quartile 1*	*Quartile 2*	*Quartile 3*	*Quartile 4*
Value Range		$150,000 to $285,000	$285,000 to $479,000	$479,000 to $990,000	> $990,000
Mean	3.44%	1.20%	3.41%	4.22%	4.00%
Std. Dev.	7.03%	7.19%	11.47%	9.86%	12.04%
Correlation of Annual Price Movements between Value Quartiles					
FL_All	1.00				
Quartile 1	0.42	1.00			
Quartile 2	0.69	0.13	1.00		
Quartile 3	0.60	0.21	0.56	1.00	
Quartile 4	0.47	0.11	0.14	-0.09	1.00

Note: Properties segmented by 2004 assessed values.

Figure 8: Florida Commercial Indices by Property Size
(1985:1 – 2004:3)



Note: FL_All is the transaction based commercial property index for Florida; > $1M is an index estimated using FL properties valued as greater than $1 million in 2005; < $1M is an index estimated using FL properties valued at less than $1 million in 2005. NPI_TBI denotes the U.S. index as reported using MIT's transaction based index for alll properties in the NCREIF portfolio.

Table 6: Chow Test of Index Estimates by Size

	Coeff.	Std. Err.	t	P>|t|		Coeff.	Std. Err.	t	P>|t|		Coeff.	Std. Err.	t	P>|t|
r794	-0.2942	0.1823	-1.61	0.11	r963	-0.0990	0.0525	-1.89	0.06	chow~881	-0.4396	0.1071	-4.11	0.00
r801	-0.2255	0.1550	-1.45	0.15	r964	0.0001	0.0519	0.00	1.00	chow~882	-0.4705	0.1012	-4.65	0.00
r802	-0.0984	0.1741	-0.57	0.57	r971	-0.0623	0.0476	-1.31	0.19	chow~883	-0.4461	0.1078	-4.14	0.00
r803	-0.2512	0.1919	-1.31	0.19	r972	0.1015	0.0446	2.27	0.02	chow~884	-0.4271	0.1058	-4.04	0.00
r804	-0.3534	0.1376	-2.57	0.01	r973	-0.1246	0.0498	-2.50	0.01	chow~891	-0.4983	0.1021	-4.88	0.00
r811	-0.4053	0.1226	-3.31	0.00	r974	0.0310	0.0451	0.69	0.49	chow~892	-0.6594	0.1032	-6.39	0.00
r812	-0.4072	0.1309	-3.11	0.00	r981	0.0259	0.0446	0.58	0.56	chow~893	-0.3388	0.1053	-3.22	0.00
r813	0.0111	0.1550	0.07	0.94	r982	-0.0426	0.0443	-0.96	0.34	chow~894	-0.5466	0.1010	-5.41	0.00
r814	-0.3041	0.1550	-1.96	0.05	r983	0.0457	0.0442	1.03	0.30	chow~901	-0.5649	0.0943	-5.99	0.00
r821	-0.4229	0.1376	-3.07	0.00	r984	0.0363	0.0444	0.82	0.41	chow~902	-0.6319	0.0999	-6.32	0.00
r822	-0.1828	0.1120	-1.63	0.10	r991	-0.0534	0.0444	-1.20	0.23	chow~903	-0.5372	0.1008	-5.33	0.00
r823	-0.1764	0.1413	-1.25	0.21	r992	0.1037	0.0425	2.44	0.02	chow~904	-0.4875	0.0988	-4.93	0.00
r824	0.0128	0.1413	0.09	0.93	r993	-0.0510	0.0430	-1.19	0.24	chow~911	-0.3415	0.1091	-3.13	0.00
r831	-0.3917	0.1309	-2.99	0.00	r994	0.0555	0.0426	1.30	0.19	chow~912	-0.7004	0.0994	-7.05	0.00
r832	-0.3087	0.1158	-2.66	0.01	r001	-0.0977	0.0424	-2.30	0.02	chow~913	-0.4164	0.0994	-4.19	0.00
r833	-0.2409	0.1102	-2.19	0.03	r002	-0.0211	0.0426	-0.50	0.62	chow~914	-0.3591	0.0933	-3.85	0.00
r834	-0.1335	0.1069	-1.25	0.21	r003	0.0651	0.0418	1.56	0.12	chow~921	-0.6121	0.0948	-6.46	0.00
r841	-0.2464	0.0943	-2.61	0.01	r004	0.0049	0.0421	0.12	0.91	chow~922	-0.5480	0.0894	-6.13	0.00
r842	-0.2610	0.0830	-3.14	0.00	r011	0.0195	0.0416	0.47	0.64	chow~923	-0.5265	0.0923	-5.70	0.00
r843	-0.2210	0.0964	-2.29	0.02	r012	-0.0036	0.0403	-0.09	0.93	chow~924	-0.4778	0.0819	-5.84	0.00
r844	0.1468	0.0864	1.70	0.09	r013	0.0519	0.0412	1.26	0.21	chow~931	-0.6029	0.0919	-6.56	0.00
r851	-0.2326	0.0914	-2.55	0.01	r014	0.0246	0.0405	0.61	0.54	chow~932	-0.5808	0.0833	-6.97	0.00
r852	-0.2716	0.0896	-3.03	0.00	r021	0.0470	0.0401	1.17	0.24	chow~933	-0.4500	0.0790	-5.69	0.00
r853	-0.2274	0.0888	-2.56	0.01	r022	0.0634	0.0394	1.61	0.11	chow~934	-0.6113	0.0737	-8.29	0.00
r854	-0.0897	0.0742	-1.21	0.23	r023	0.0651	0.0391	1.67	0.10	chow~941	-0.4854	0.0799	-6.08	0.00
r861	-0.1246	0.0843	-1.48	0.14	r024	0.0494	0.0390	1.27	0.21	chow~942	-0.3877	0.0764	-5.07	0.00
r862	-0.1886	0.0769	-2.45	0.01	r031	0.0856	0.0389	2.20	0.03	chow~943	-0.4284	0.0771	-5.56	0.00
r863	-0.0862	0.0734	-1.17	0.24	r032	0.0724	0.0386	1.87	0.06	chow~944	-0.3597	0.0724	-4.97	0.00
r864	-0.1547	0.0576	-2.69	0.01	r033	0.0816	0.0379	2.15	0.03	chow~951	-0.4734	0.0782	-6.06	0.00
r871	-0.2057	0.0880	-2.34	0.02	r034	0.0785	0.0380	2.07	0.04	chow~952	-0.4703	0.0735	-6.40	0.00
r872	-0.2750	0.0836	-3.29	0.00	r041	0.0382	0.0378	1.01	0.31	chow~953	-0.5961	0.0769	-7.75	0.00
r873	-0.0594	0.0794	-0.75	0.45	r042	0.0004	0.0374	0.01	0.99	chow~954	-0.2448	0.0709	-3.45	0.00
r874	-0.1638	0.0769	-2.13	0.03	r043	-0.0393	0.0409	-0.96	0.34	chow~961	-0.2892	0.0722	-4.01	0.00
r881	-0.2222	0.0769	-2.89	0.00	Constant	0.1559	0.0321	4.86	0.00	chow~962	-0.3433	0.0666	-5.15	0.00
r882	-0.0772	0.0708	-1.09	0.28	chow~794	-1.0067	0.2576	-3.91	0.00	chow~963	-0.3656	0.0701	-5.21	0.00
r883	-0.2105	0.0750	-2.80	0.01	chow~801	-0.9064	0.2123	-4.27	0.00	chow~964	-0.3083	0.0680	-4.53	0.00
r884	-0.1487	0.0750	-1.98	0.05	chow~802	-1.0043	0.2459	-4.08	0.00	chow~971	-0.4040	0.0670	-6.03	0.00
r891	-0.0841	0.0682	-1.23	0.22	chow~803	-0.8857	0.2500	-3.54	0.00	chow~972	-0.5426	0.0631	-8.60	0.00
r892	0.0145	0.0688	0.21	0.83	chow~804	-0.1384	0.1969	-0.70	0.48	chow~973	-0.1122	0.0673	-1.67	0.10
r893	-0.1308	0.0730	-1.79	0.07	chow~811	-0.3739	0.1713	-2.18	0.03	chow~974	-0.3252	0.0611	-5.32	0.00
r894	-0.0526	0.0691	-0.76	0.45	chow~812	-0.4475	0.1807	-2.48	0.01	chow~981	-0.3517	0.0620	-5.67	0.00
r901	-0.1244	0.0650	-1.91	0.06	chow~813	-0.7882	0.2664	-2.96	0.00	chow~982	-0.2262	0.0613	-3.69	0.00
r902	-0.0882	0.0631	-1.40	0.16	chow~814	-0.4446	0.1989	-2.24	0.03	chow~983	-0.1905	0.0607	-3.14	0.00
r903	-0.1253	0.0673	-1.86	0.06	chow~821	-0.4051	0.1770	-2.29	0.02	chow~984	-0.2258	0.0604	-3.74	0.00
r904	0.0082	0.0750	0.11	0.91	chow~822	-1.0281	0.1868	-5.50	0.00	chow~991	-0.2024	0.0619	-3.27	0.00
r911	-0.2659	0.0779	-3.41	0.00	chow~823	-0.8094	0.1945	-4.16	0.00	chow~992	-0.2468	0.0597	-4.14	0.00
r912	-0.2071	0.0701	-2.96	0.00	chow~824	-0.9073	0.1788	-5.07	0.00	chow~993	-0.1021	0.0603	-1.69	0.09
r913	-0.2481	0.0701	-3.54	0.00	chow~831	-0.7219	0.1718	-4.20	0.00	chow~994	-0.2306	0.0593	-3.89	0.00
r914	-0.2917	0.0697	-4.18	0.00	chow~832	-0.6929	0.1509	-4.59	0.00	chow~001	-0.1622	0.0592	-2.74	0.01
r921	-0.1524	0.0726	-2.10	0.04	chow~833	-0.3973	0.1482	-2.68	0.01	chow~002	-0.2109	0.0605	-3.49	0.00
r922	-0.0984	0.0665	-1.48	0.14	chow~834	-0.4217	0.1458	-2.89	0.00	chow~003	-0.2642	0.0595	-4.44	0.00
r923	-0.1931	0.0657	-2.94	0.00	chow~841	-0.7848	0.1335	-5.88	0.00	chow~004	-0.1802	0.0587	-3.07	0.00
r924	-0.1767	0.0627	-2.82	0.01	chow~842	-0.7015	0.1215	-5.77	0.00	chow~011	-0.2682	0.0586	-4.58	0.00
r931	-0.1657	0.0685	-2.42	0.02	chow~843	-0.5147	0.1402	-3.67	0.00	chow~012	-0.0897	0.0568	-1.58	0.11
r932	-0.0716	0.0621	-1.15	0.25	chow~844	-0.8611	0.1179	-7.30	0.00	chow~013	-0.1407	0.0578	-2.43	0.02
r933	-0.1621	0.0602	-2.69	0.01	chow~851	-0.6030	0.1413	-4.27	0.00	chow~014	-0.1394	0.0566	-2.46	0.01
r934	-0.0716	0.0538	-1.33	0.18	chow~852	-0.5605	0.1402	-4.00	0.00	chow~021	-0.1864	0.0571	-3.26	0.00
r941	-0.1264	0.0592	-2.13	0.03	chow~853	-0.3680	0.1372	-2.68	0.01	chow~022	-0.2029	0.0559	-3.63	0.00
r942	-0.2263	0.0548	-4.13	0.00	chow~854	-0.6591	0.1133	-5.82	0.00	chow~023	-0.1536	0.0556	-2.76	0.01
r943	-0.1967	0.0540	-3.64	0.00	chow~861	-0.6401	0.1267	-5.05	0.00	chow~024	-0.1278	0.0546	-2.34	0.02
r944	-0.1763	0.0543	-3.25	0.00	chow~862	-0.6530	0.1140	-5.73	0.00	chow~031	-0.1242	0.0550	-2.26	0.02
r951	-0.2012	0.0520	-3.87	0.00	chow~863	-0.5626	0.1139	-4.94	0.00	chow~032	-0.1214	0.0538	-2.25	0.02
r952	-0.0874	0.0535	-1.63	0.10	chow~864	-0.5853	0.0861	-6.80	0.00	chow~033	-0.0816	0.0538	-1.52	0.13
r953	0.0440	0.0545	0.81	0.42	chow~871	-0.7199	0.1434	-5.02	0.00	chow~034	-0.0710	0.0535	-1.33	0.19
r954	-0.1094	0.0506	-2.16	0.03	chow~872	-0.4829	0.1288	-3.75	0.00	chow~041	-0.0441	0.0528	-0.84	0.40
r961	-0.1586	0.0507	-3.13	0.00	chow~873	-0.4784	0.1281	-3.74	0.00	chow~042	-0.0030	0.0525	-0.06	0.95
r962	-0.0064	0.0472	-0.14	0.89	chow~874	-0.3519	0.1107	-3.18	0.00	chow~043	0.0058	0.0563	0.10	0.92
										Chow	-0.0084	0.0438	-0.19	0.85

F-test that all chow indicator variables are 0: F(100,40809) = 11.06
Probability > F = 0.0000

Notes:
All the above results are from a single estimation. The coefficients are shown in multiple columns simply for display purposes.
The chow indicator variables are set to 1 if the property assessed value is large and 0 if it is small. Medium-sized properties are excluded from this estimation.
Large properties are in the 80th, 90th and 100th decile. Small properties are in the 10th, 20th and 30th decile.
The variables labeled "r794" to "r043" are set equal to 1 if the most recent property sale took place in that year and quarter. "r794", for example, corresponds to the year 1979 and the 4th quarter.
The variable "chow~794" is the chow indicator variable multipled by the r794 variable, and similarly for all quarters until 2004, quarter 3.
The coefficients on r794 to r043 and represent the results for small properties only.
The coefficients on chow~794 to chow~043 represent the difference between the coefficients on big properties and the coefficients on small properties.
If the coefficients on the Chow variables are significant, then there is a significant difference between the results for the small properties and the large properties.